REMARKS

Applicants are canceling claims 10-25 without prejudice as to filing a divisional application for them. Applicants have canceled the elected claims 1-9 and replaced them with claims 26-42 to better define the invention.

In this invention, the layers 11 that make up outer skins 12 include unidirectional or collimated fibers. Furthermore, the layers that make up the inner supports or braided socks 41 (Figure 4) include collimated fibers. Collimated fibers are needed to provide the desired strength for the structural component. Also, in the preferred embodiment, sock 41 is of a fabric that is braided into a tubular configuration around each mandrel 5.

All of the claims require that the structural component have unidirectional fibers in the outer skins as well as the inner supports. The references do not show this feature. Applicants are enclosing a translation of French Patent 1,262,381, which discloses a composite fabric that is wrapped around each mandrel body 37. There is no mention that this fabric contains collimated fibers, however. The patent discloses upper and lower skins 54 and 53 of fiberglass fabric. However, there is no mention that either of the skins would have collimated fibers.

Similarly, in EP 0 773 099, mandrels 222 are wrapped with one or more sheets 224 of a curable composite material. Sheets 212 and 232 overlay the wrapped mandrels in the mold to for outer skins. There is no mention that any of the sheets contain collimated fibers. Applicants thus submit that claim 26 should be allowed.

Claim 27 depends from claim 26, requiring that at least some of the inner supports comprise fibers that are braided into a tubular configuration. In French '381, the sheet wrapped around mandrel body 37 is shown in a two-dimensional plane in Figure 7. It is a single sheet that is wrapped a plurality of times around mandrel body 37. The sheet is not woven into a tubular configuration, rather is flat. After wrapping around the mandrel, the sheet is secured by a wire

that is wound around the mandrel as shown in Figure 6. (page 4 of the translation, third paragraph from the bottom).

EP '099 discloses wrapping one or more sheets 224 of a curable composite material around a mandrel (col. 2, lines 52, 53). Column 3, lines 1-3, state that the mandrels may be "braided, filament wound or applied by fiber placement". The specification further states that each of the mandrels is preferably wrapped three times. Although the patent mentions the term "braided", the patent does not indicate that the fabric should be braided into a tubular configuration. A braid can be a flat two-dimensional piece of material with fibers interlaced with each other. The statement that the mandrel is wrapped three times implies that if braided, it would be braided material that is wrapped three times around the mandrel. The specification does not suggest braiding the sheets into a tubular configuration as required in claim 27.

Claim 28 depends from claim 26, requiring an adhesive layer located between the inner supports and the outer skins. This adhesive layer is in addition to any resin infused into the outer skins and inner supports. Neither reference discloses the use of an adhesive layer in addition to the resin.

Claim 29 claims the structural component in an intermediate stage when the component is pre-cured and preferably located within a mold. Claim 29 also requires that the inner skins and the inner supports have layers of collimated fibers. Neither reference discloses this feature.

Claim 31 requires that at least one of the layers of the outer skins be unimpregnated within resin and at least one of the layers of the outer skin be impregnated with resin. The French Patent '381 discloses unimpregnated fabric that is subsequently infused with resin by pouring the resin over the layers after laid up in the mold. This procedure is discussed on pages 4 and 5 of the translation. The reference does not disclose preimpregnation of any of the layers.

EP '099 mentions that the material wrapped around the mandrels can be alternately impregnated with thermoset prepreg material. The term "alternately" is used in this context to imply that the material can be either impregnated or not impregnated. There is no disclosure that layers would alternate with each other, one impregnated and the other not impregnated. Column 3, lines 6-8, indicates that the sheets can be of the same material as that wrapped around the mandrels. Presumably, this material can be either impregnated or not impregnated. However, the '099 patent does not disclose that at least one layer is impregnated and another layer is not.

Claim 32 depends from claim 29, requiring that at least one of the layers of the outer skin be unimpregnated, another layer of the outer skin being fully impregnated, and at least one of the layers of the outer skin be partially impregnated with resin. The references do not disclose layers that are impregnated with different contents of resin as required in claim 32.

Claim 34 requires that the outer skins be infused with a resin and at least partially cured. It further requires a layer of adhesive located between each of the inner supports and the outer skins. Neither of the references teaches partially curing the outer skins, then placing a layer of adhesive between the outer skins and the component.

Claim 36 requires the outer skins form layers of fabric that include collimated fibers. Claim 36 requires a plurality of socks, each enclosing the mandrels. It requires that the socks be braided into a tubular configuration and have collimated fibers. The references do not show collimated fibers. The references do not show a sock braided into a tubular configuration. Claim 38 requires that at least some of the layers of the outer skins be unimpregnated, while others are impregnated with resin. This is not shown in the references as mentioned above. Claim 39 is similar to claim 32 discussed above. Claim 41 is similar to claim 34 discussed above.

It is respectfully submitted that the application is now in condition for allowance and favorable action is respectfully requested.

Respectfully submitted,

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26. A structural component comprising:

a pair of outer skins, each formed from layers of fibers that include a plurality of collimated fibers infused with a thermosetting resin; and

a plurality of inner supports between the outer skins, each of the inner supports having a plurality of collimated fibers infused with a thermosetting resin and bonded to the outer skins.

27. The structural component of claim 26, wherein at least some of the inner supports comprise fibers that are braided into a tubular configuration.

28. The structural component of claim 26, further comprising adhesive layers located between the inner supports and the outer skins.

29. A pre-cured structural component comprising:

a pair of outer skins, each formed from composite layers of fabric that include a layer of collimated fibers;

a plurality of removable mandrels located between the outer skins; and

a plurality of inner supports carried by the mandrels, each of the inner supports formed of composite layers of fabric that include a layer of collimated fibers, the inner supports having surfaces in contact with the outer skins to couple the outer skins together; and wherein

the structural component is adapted to be cured within a mold..

30. The structural component of claim 29 wherein the layers of the outer skins are unimpregnated with resin.

31. The structural component of claim 29 wherein at least one of the layers of the outer skins is unimpregnated with resin, and at least one of the layers of the outer skin is impregnated with resin.

32. The structural component of claim 29 wherein at least one of the layers of the outer skins is unimpregnated with resin, at least one of the layers of the outer skin is fully impregnated with resin, and at least one of the layers of the outer skins is partially impregnated with resin.

33. The structural component of claim 29 wherein the layers of the outer skins are impregnated with resin.

34. The structural component of claim 29 wherein the outer skins are infused with a resin and at least partially cured, and wherein the component further comprises a layer of adhesive located between each of the inner supports and the outer skins.

35. The structural component of claim 29 wherein the layers of the outer skin are infused with cured resin, and the inner supports are infused with uncured resin.

36. A pre-cured structural component comprising:

a pair of outer skins, each formed from composite layers of fibers that include a plurality of collimated fibers;

a plurality of removable mandrels located between the outer skins;

a plurality of composite socks enclosing each of the mandrels, each of the socks being braided into a tubular configuration and including a plurality of collimated fibers, the socks having surfaces in contact with the outer skins and with adjacent socks to couple the outer skins together; and wherein

the structural component is adapted to be cured within a mold.

37. The structural component of claim 36 wherein the layers of the outer skins are unimpregnated with resin.

38. The structural component of claim 36 wherein at least one of the layers of the outer skins is unimpregnated with resin, and at least one of the layers of the outer skin is impregnated with resin.

39. The structural component of claim 36 wherein at least one of the layers of the outer skins is unimpregnated with resin, at least one of the layers of the outer skin is fully impregnated with resin, and at least one of the layers of the outer skins is partially impregnated with resin.

40. The structural component of claim 36 wherein the layers of the outer skins are impregnated with resin.

41. The structural component of claim 36 wherein the layers of the outer skin are infused with a resin and at least partially cured, and wherein the component further comprises a layer of adhesive located between each of the socks and the outer skins.

42. The structural component of claim 36 wherein the layers of the outer skin are infused with resin and cured, and the socks are infused with uncured resin.

REPUBLIC OF FRANCE
MINISTRY OF INDUSTRY
INDUSTRIAL PROPERTY DEPARTMENT

PATENT OF INVENTION

P.V. No. 832,753 **No. 1,262,381**
International Classification: B 29 c – B29 d

Two-piece mold for molding wings or structural shapes of layered, reinforced, hollowed plastic materials.

Company termed: PARSONS CORPORATION, domiciled in the United States of America.

Applied for on July 12, 1960, at 14:45 in Paris
Issued via decree dated April 17, 1961.
(Bulletin Officiel de la Propriete Industrielle – "Official Bulletin of Industrial Property", No. 21, 1961)

This invention concerns the use of two-piece or complementary molds to make objects with hollow structures, such as lifting or bearing surfaces or structurally shaped wings with a reinforcement mesh; and it particularly applies to complementary two-piece molded devices that include mandrels or internal cores, in terms of size, and to processes for molding structural shapes made of plastic materials, reinforced by fabric, with the use of said mold.

Up to now, we have not used two-piece molds in general to mold structurally-shaped wings. To the contrary, reinforcing material, such as fiberglass, was coated and impregnated with a fluid plastic resin, then molded against a single molded surface (either male or female) by a fluid under pressure, for example, beginning with an empty sac.

In molding wing shrouds, with thin walls presenting a thin reinforcement mesh subject to standards governing the uniform resistance and weight of aircraft structures, a difficult problem arises that has not been resolved satisfactorily until now. All wall and mesh thicknesses must be minutely adjusted, as must the ratio of the plastic material to the reinforcing material, as well as its distribution within and upstream of the reinforcing material.

This invention makes it possible to resolve these problems. In addition, it proposes to provide:

Molds consisting of complementary half-molds and inner mandrels that are self-adjusting in their positions within the interior of the molds, thus providing the shroud's desired thicknesses and volumes;

Transversal reinforcement molding, precisely formed;

A means to permit the use of mandrels that are automatically positioned during the course of molding tapered, lifting/bearing or winged surfaces;

A procedure for molding objects made of plastic material that is reinforced by permeable sheets for reinforcement purposes, to obtain a regular distribution of the plastic material on and around the material, enabling the mandrels used in the hollow objects to be positioned correctly under the pressures created by molding; so as to be able to form a transverse reinforcement mesh within these molded objects.

The previous practice of molding stratified wings with the aid of a fabric made of fiberglass and of fluid plastic resins necessitated the wetting, separated by the fluid plastic material of each sheet or shroud of fiberglass fabric, to the extent it was placed within the molding or around a mandrel. However, in order to reach significant, acceptable fabric-to-resin ratios, the mass of resin that is added to that of the fabric makes it difficult, if not impossible, to shroud the mandrels by means of such a wet fabric, sufficiently narrow and tightened so as to obtain perfect alignment and separation of the fabric's laminas. Likewise, it becomes more difficult to previously position these mandrels shrouded in the wetted state during the complementary mold halves, and to install them in-place; particularly when it is necessary to adjust a large number of triangular mandrels of slight tolerances between the complementary mandrel halves.

To overcome these difficulties, and to attain the goals mentioned above, as well as others that will be cited hereinafter, the requester supplies an equipment item and a process which shall be described below, referencing the designs per annex, in which:

Figure 1 is an exploded perspective view of the upper and lower complementary mold halves, representing certain gudgeons employed with the latter;

Figure 2 is a perspective view of the set of mandrels employed in the mold halves of Figure 1;

Figure 3 is a section following Line 3-3 of Figure 1, representing the halves of the mold in Figure 1, with the set of mandrels in Figure 2 placed into position.

Figure 4 is a section analogous to that in Figure 3, following line 4-4 in Figure 1:

Figure 5 is a perspective view of a mandrel, presenting a means for terminating the mesh near the end of the wing's base;

Figure 6 is a perspective view of a typical mandrel, shown as shrouded in a fiberglass fabric.

Figure 7 is the drawing developed in the two-dimensional plane, concerning the fiberglass fabric shroud shown in Figure 6;

Figure 8 is a perspective view of the lower half of the mold, on which are deposited layers of fiberglass fabric and in which are installed a series of shrouded mandrels; and

Figure 9 is a perspective view of a wing after molding, representing a molded attachment base console, which is intended to be introduced there.

Referring now to the drawings, a lower half has been provided, designated as (11) in general, and an upper half of the mold, designated as (12) in general, that are formed in any general fashion, such as from hard laminated wood, whose platform is larger than the wing that is to be molded to it. The lower mold half (11) includes a concave cavity surface (13) which conforms to the contour of the outer surface of the wing that is to be molded, on one side of its chord; and the mold's upper half (12) presents a concave cavity surface (14), conforming to the form of the wing on the other side of its chord. The cavities, (13) and (14), present flat marginal portions (15) to the outside and in the vicinity of their edges, which correspond to the edges leading to and away from the wing. The corresponding marginal portions (15) of the upper and lower molds are mutually parallel and, once the mold halves are united, are separated from each other by a sufficient distance to receive the edges of the material that is to be molded there.

As shown in Figure 1, the surfaces (13) (14) of the concave cavity taper off in the direction of an edge of the upper and lower halves (11) (12) of the mold, to form a smaller wing at its extremity than at its base. The lower surface (13) of the concave cavity terminates at this edge, at a surface belonging to the extremity (16) of the molding (to form an extremity of the wing according to a right section) and rises perpendicularly to the lower surface (13) of the concave cavity. The form of the surface of the extremity (16) corresponds to that of the section of the wing's extremity. This surface (16) is the internal surface of a bloc at the end of the mold, generally designated by (17), which is sectioned along the upper edge so as to correspond to a continuation in the direction of the extremity of the upper surface (14) of the concave cavity. Thus, the end portion of the molding device is closed, except for the discharge grooves (18) arranged transversally at the upper edge of the molding's end block (17).

The mold's lower and upper halves (11) (12) present edges of blocks (19) that are used in aligning and tightening the mold halves to each other, and which extend beyond the flat marginal parts (15) that delimit the cavity's contour surfaces (13) (14). The block edges (19) present a series of vertical, sleeved bores (20) used to arrange the molding halves (11) (12) into alignment, one after the other, maintaining alignment through the use of an alignment gudgeon (21) installed in each of the aligned vertical bore sets (20).

When the block edges (19) of the upper and lower molding halves are tightened against each other, they serve to establish the molding's internal height between the concave cavity's structurally shaped surfaces (13) (14), at the desired height, to determine the wing's thickness.

We employ simple tightening methods, as determined by practice, to apply pressure between the molding halves (13) (14). As an example of such a tightening device, the alignment gudgeon's (21) extremities may contain thread, nut and washer (22) (23) (24).

Near the basal end of the cavity's lower surface (13), the molding's lower half (11) is equipped with a channel (25) that constitutes an extension (26) in the direction of the base of the lower half (11) of the molding. The upper half (12) of the molding presents an overhanging part (27) in the direction of the base; and aligned vertical bores (28) are provided, for example, between the channel (25) and the overhang (27) in the immediate vicinity of the base edges of the cavity's surfaces (13) (14). The vertical aligned bores (26) /sic/ are provided stop gudgeons (29) that are constructed and located so that their median portion abuts against the base extremities of the mandrels, which shall be described below.

On the outside of the channel (25) to the lower extension (26), in the direction of the base, the lower half (12) of the molding is fitted with a block (30) of positioning gudgeons, presenting a series of steps with a horizontal surface (31) along the upper surface, each of them presenting a vertical bore (32) of positioned gudgeons. The elements (32) of the positioning gudgeons receive positioning gudgeons (33) from the base of the mandrel, and can be equipped at their upper ends by transversal gudgeons (34) so they be easily drawn.

The block (17) of the molding extremity is traversed by horizontal bores (35), and receives a positioning gudgeon (36) from the ends of the mandrel, which may display construction identical to that of the positioning gudgeons (33) at the base of the mandrel. The layout of the end block's bores (35) will be described below.

The mandrels that constitute the set represented in Figure 2 can also be made of laminated hardwood. As is seen from a comparison of Figure 2 with Figures 1 and 9, the mandrels shown are tapered and are mutually complementary; and, when arranged within the interior of the molding halves (11) (12), jointly provide the precise spaces that are necessary to ensure the tapered wing's conformation, as designated in a general sense by *a* on Figure 9, so that its upper and lower surfaces, *b, c,* respectively, its vertical mesh *d* and its diagonal reinforcement mesh *e*, can be formed with precise tolerances. Mesh *d* and *e* supply the desired spaces within the wing's interior *a*: the form and volume of the mandrels to be described correspond in general to the form and volume of these desired spaces.

Each of the mandrels of the set represented in Figure 2 presents a mandrel body generally designed as 37, which extends from the molding's end block (17) over a length that is at least equal to the length of the span of the cavity in molding halves (11) (12); and the body in fact can be made slightly longer so as to reach the end of the base of the cavity, to abut against the mid part of the vertical stop gudgeon (29) that is provided for it, as shown in Figures 3 and 4. Each of these mandrel bodies (37) presents a longitudinal steel reinforcement (38) that includes a part (39) jutting out from the end of the base and that has, in the vicinity of its outer edge, a vertical bore (40) so spaced as to be capable of alignment with and above the corresponding vertical bore (32) of the positioning gudgeon, set in the block (30) as represented in Figures 3, 4 and 8. The bore (40) has a diameter that is sufficiently greater than that of the positioning gudgeon (33) from the base and from the mandrel that is adjusted to it, so as to enable the reinforcement (38) to "abut" vertically on the latter, with a certain degree of freedom.

As represented in Figure 2, the mandrels generally designated as (37) include a mandrel (41) for the leading edge and a mandrel (42) for the trailing edge, both of which have a markedly triangular transversal section. In order to achieve the triangular wing construction represented in Figure 9, the greater number of mandrels located between the mandrels (41) of the leading edge and (42) of the trailing edge also contain a triangular transversal section. Each of these markedly triangular intermediate mandrels is located either near the upper wall or the lower wall of the wing represented in Figure 9, which is slightly shaped to provide the hollow wing contour depicted. Thus, the mandrels consisting of large surfaces, or bases, presented near the upper surface (14) of the concave cavity, and which present peaks near the lower surface (13) of the concave cavity, are designated by upper triangular mandrels (43). In corresponding fashion, the generally triangular mandrels that present large surfaces or bases near the lower surface (13) of the concave cavity, and the peaks near the upper surface (14), are matched by lower triangular mandrels (44).

In providing connections to affix the wing *a,* the diagonal reinforcement mesh is omitted, beginning with two spans *f* and *g;* the mandrels provided for these spans present a markedly trapezoidal transversal section and are designated by reference number 45.

It is considered advantageous to arrange the ends of certain mandrels (37) relative to the molding's end (17) block. Thus, mandrel 41, of the leading edge, mandrel 42, of the trailing edge, each of the lower triangular mandrels (44) and each of trapezoidal mandrels (45) are fitted at their ends with a horizontal bore (46), relative to the corresponding horizontal bore (35), so that a gudgeon at the end (36) that is introduced through the end bore (35) is able to project into the end of each of these mandrels, and to position it. These mandrels, whose ends are thus positioned, can nonetheless freely "float" in an inclined fashion toward the top to the basal end, and with reference to this play between the vertical bore (40) and the gudgeon (33). Nonetheless, each of the triangular upper mandrels (43) is free at its end. This freedom that characterizes the triangular upper mandrels (43) (which alternate in a general fashion among the mandrels, whose ends are installed in a fixed manner) allows the upper mandrels (43) to adjust freely, vertically along their entire length and, at the same time, in oblique fashion while inclining, and also oscillating within the plane of a chord around their gudgeons, which position the mandrel base. This inclination and oscillation are of slight amplitude, even though significant relative to the tolerances allowable in the wall and the mesh that constitutes the wing *a* represented in Figure 9.

The positions relative to an upper triangular mandrel (43) and a lower triangular mandrel (44) between the molding halves (11) (12) are shown in Figures 3 and 4, taken at the posts in the direction of the chord that corresponds to two of the steps adjacent to the horizontal surface (31) and to the positioning gudgeon block (30).

Thus, the lower triangular mandrel (44), which occupies the greater part of the space within the molding cavity in the section shown in Figure 3, is affixed at its end by a horizontal gudgeon (36) in its bore at the end (46); but then, it can float independently upward and downward at its basal end. On the other hand, the upper triangular mandrel (43) which occupies the greater part of the molding cavity in the section represented in Figure 4, even though it is affixed in an analogous manner at its basal extremity, is not affixed to its end and, thus, is able to adjust, through an oblique movement, perpendicularly to the plane of the section shown in Figure 4. This has made it possible, to a remarkable degree, to adapt the mandrels, each with respect to the others and relative to the cavity of the molding, so as to obtain efficient adjustment of the action of the fiberglass structure and the resin that is to be molded in the spaces contained among them.

In comparing the set of mandrels represented in Figure 2 with the fully molded wing structure shown in Figure 9, and, in particular, relative to the major span *f* shown at the base of Figure 9, the width relative to the chord of the *f* span is equal to the width of the trapezoidal mandrel (45) at the surface, in the direction of the chord or "base" of the adjacent upper mandrel, designated by (43), and shown alone in perspective in Figure 5, looking from the summit located within the wing's interior surface. Near the base of the mandrel (43), the diagonal surface (47) presents a thicker part of the step (48); in analogous fashion, the upper surface (49) (as shown in Figure 2), presents a step (50). The steps (48) and (50) have thicknesses equal to those of the diagonal or reinforcement mesh *e* and of the vertical mesh respectively, which are provided in a general sense as a reinforcement within the wing's interior *e*, shown in Figure 9. Inasmuch as these steps (48) and (50) make it possible to eliminate the diagonal and vertical mesh, *e, d* respectively, only in the area limited to the steps, an expansion of the span *f* is encountered, to a width greater than that of the trapezoidal mandrel (45) alone. At its base, span *f* receives the fill-in unit from the base *h*, which is joined adhesively to the span *f* after the wing *a* is molded. The *h* fill-in unit's main function is to provide a means of attachment for the wing *a* and, for this purpose, it presents a cylindrical attachment bore *i*.

The molding process, with wings constructed with a reinforced shroud according to this invention, consists, in general, of arranging the layers of a woven reinforcement fabric (without a fluid plastic material) on a lower molding half, shrouding layers of reinforcing fabric woven around cores or mandrels, adding a quantity of fluid plastic material on the latter and arranging the layers of reinforcement fabric, which are woven so as to abut against the molding's upper half. As a final stage, the molding halves are tightened together in complementary fashion, to establish an inner height for the molding and produce a previously determined internal volume. Thus, the fluid plastic material is extruded for the purpose of distributing it across, between and around layers of the reinforcing fabric, which is woven so as to allow penetration of all of its interstices. A certain amount of the plastic material must be obtained, exceeding the quantity that is necessary for the desired ratio of fabric to the plastic material. Pressure extrudes the excess amount through evacuation bores (18) and out the end of the base of the molding.

We may now describe the particular method for implementing this process, by utilizing the elements of the moldings represented in the drawings;

Each molding body can be shrouded through the use of a permeable reinforcing material, such as the fiberglass fabric that shrouds the mandrel (51), and can be attached by a wire as shown in Figure 6. The shroud, made of fabric, preferably is made a bit larger than necessary. After the shrouding is completed, it is trimmed at its extremities, to the mandrel's dimensions. In order to form and reinforce the wing-tip, the excess tissue is trimmed from the mandrel's two sides. This, left in a projecting form from the other side of the mandrel, is trimmed to form a triangular cover for the tip (52). To facilitate the arrangement within the molding, it preferably consists of a continuation of the molding (51) on the lower side of the mandrel (37). The shrouding that is trimmed in this manner presents a flat design that is markedly like that shown in Figure 7.

Regarding the stepped mandrel (43), the fabric shroud is trimmed at the basal end to terminate at steps 48 and 50; and the mandrels' fabric shrouds located near these steps are trimmed in analogous fashion, at this location.

Sheets of fiberglass fabric, designated as lower surface sheets (53), are trimmed to cover the lower surface (16) of the concave cavity and are directed upward against the surface of the molding end (17), extending to the upper edge of the molding end block (17). Following the chord's direction, these sheets of fiberglass extend into the flat, marginal parts (15), and cover them. The sheets that cover the upper

surfaces (54) are trimmed to extend, in analogous manner, in the same direction as the chord, to cover the entire rear portion (14) of the concave cavity, as well as the flat marginal parts (15) at their leading and trailing edges, to then rejoin the end part that is directed to the upper part (55) of the lower shrouding sheets (53).

The lower coating sheets (53) are carefully placed onto the molding's lower half, in the dry state, together with their end parts, and are directed upward (55) and arranged against the molding's end surface (16). The lower triangular mandrels (44), shrouded as shown in Figure 6, are arranged on the lower covering sheets with their end- covering parts (52) directed upwards and installed there; and the positioning gudgeons (36) are introduced through bores (35) of the end block so as to pierce the portions covering the end (22) of the coating sheets (53), and penetrating the bores (46) of the mandrel ends. Each of these lower triangular mandrels (44) is affixed by the part jutting out at the basal end (39) of its steel reinforcing element (38), in block (30) of the positioning gudgeon, by means of a basal positioning vertical gudgeon (33).

At this stage, it may also be convenient to place, on the lower coating sheets (53), the leading edge mandrel (41), the trailing edge mandrel (42) and the trapezoidal mandrels (45) shrouded in fabric, and to affix them in place in an analogous manner at their basal and end extremities.

A quantity of fluid plastic resin, with a syrupy consistency, is then poured in a generalized manner over the lower coating sheets (53) and on the mandrels that were placed on the latter. The upper triangular mandrels (43) (and one or the other of the other mandrels which have yet to be placed on the lower coating sheets (53) are then placed into position.

The upper triangular mandrels (43), as represented, are not equipped with mandrel end bores (46). They are laid down in their position in a clearly alternating manner, placed upon the other mandrels and on the fluid plastic material which can be found on the latter, in the positions which they are able to freely occupy; and the jutting parts (49) at the basal end of their steel reinforcing elements (38) are affixed by a gudgeon in block (30), in analogous manner.

When the entire quantity of the fluid plastic material that is to be utilized has been poured onto the mandrels within the molding interior (either in total at a single time or progressively as the mandrels are installed) the upper coating sheets (54) are installed so as to extend in the direction of the chord between the flat, marginal parts 15 at the molding cavity's leading and trailing edges, and to extend from the base of the latter to its end.

According to one variant, it is possible to provide coating sheets within the mandrel's inner half, from the trailing edge, which can extend forward toward the wing's leading edge and around the latter, and be directed onto the mandrel, and the plastic material is employed in forming the upper surface coatings.

By virtue of the tapered form of the mandrels and the molding's cavity, one proceeds to the next, additional stage: the upper half (12) of the molding is installed with regard to the molding's lower half (11), the sleeved vertical bores (20) are aligned, each relative to the other, and the alignment gudgeons (21) are introduced into the sleeved vertical bores. Nonetheless, before tightening the molding's halves (11) and (12), a stop gudgeon (29) is introduced into each of the pairs of aligned vertical bores/reams for the stop gudgeons (28) so that their mid portions are strictly adjusted against the basal ends of each of the mandrel's bodies (37). The molding halves (11), (12) are then drawn, each against the other, by a tightening method, such as, for example, by tightening by threading, nut and washer (22), (23) and (24) of the alignment gudgeons. The fluid pressure generated by this tightening within the molding tends to extrude or charge each of the tapered mandrels toward the outside and the basal ends; the fact that the latter abut against the stop gudgeons (29) prevents the mandrels from effecting this lengthwise displacement and avoids the tendency by the vertical bores (40) of the basal extremities (39) of the steel reinforcements to jam against the positioning gudgeons (33).

The molding then is achieved and completed in the customary manner, for the specific plastic molding resin employed, which may consist simply of allowing the resin to harden. One then opens the molding halves (11), (12), withdraws the tapered mandrels (37) and removes the mounted object, then deburrs the coating edges extending into the flat marginal parts (15). Finally, the longest spans *f* and *g* are provided filling units affixed by an adhesive, such as for the *h* filling unit.

It appears that the syrupy consistency of the plastic resin and the limitation inherent in the multiple thicknesses of the fabric, and in the narrow spaces provided between the adjacent mandrels and the molding's shaped, sectional surfaces, together ensure that the entire system maintains pressure in the fluid, in response to that of the mandrels, regulating their position in order to reach an equilibrium. This equilibrium tends to establish a constant ratio, in the molded structure as a whole, in the resin and in the fabric. Thus, for the possible ratios of plastic resin to the fabric, the thicknesses of the coatings and the mesh are adjusted by establishing the number of thicknesses/layers of the fabric existing in each wing area, by dry shrouding the mandrels and arranging them to ensure their freedom between the molding halves, then allowing the mandrels to adjust their positions in order to achieve a uniform distribution of the resin in response to the force exerted on the molding's complementary halves.

Naturally, the invention is not limited to the manner of implementation that is described and represented, and can receive numerous variants that are consistent with the spirit and framework of the invention.

SUMMARY

A. This consists of a process for utilizing a molding device made of two complementary halves, including an upper half, a lower half and a series of internal mandrels extend in the span's direction, to form wings of reinforced, stratified plastic material with an inner mesh, a procedure that is characterized by the following points, either separately or in combination;

1. It consists of arranging for a previously determined number of layers, made of a permeable reinforcement material, over the lower half of the molding to separately shroud the mandrels through the use of a previously determined number of layers made of the permeable reinforcement material, arranging the shrouded mandrels to align with the direction of the chord, relative to the material constituting the lower half of the molding, with the addition of a certain quantity of fluid plastic material to the shrouded mandrels, applying, from above, a previously determined number of layers of permeable reinforcing material, then assembling the molding's upper half, which is previously determined relative to the lower half, tightening it in the presence of the plastic material so as to distribute it under a cross fluid pressure, between and around the beds made of reinforcement material, employing this fluid pressure to adjust the positions of the inner mandrels relative to the molding's upper and lower halves, and the first relative to the others, then hardening the material in order to form a molded object and remove the object from the molding device;

2. In utilizing a molding device made of two pieces, that are mutually complementary and include a tapered upper molding half, a tapered lower half including an end part at its smallest extremity and a series of internal mandrels arranged in the direction of the span. Said process consists of arranging a layer of permeable reinforcement material onto the lower half of the molding, through the use of a layer of material that is sufficient to cover the inner surface of the molding's end portion, so as to direct it against the latter, so as to separately shroud the mandrels with layers made of the permeable reinforcing material, which projects sufficiently over a surface at the end of each mandrel in order to cover the end, arranging the shrouded mandrels in line with the direction of the chord of the material composing the lower half of the molding, with the material at the end of the mandrel being pressed against the upwardly-directed material in the end portion of the molding, blocking the basal ends of the molding, when it encounters a longitudinal movement outside the molding, adding a certain quantity of fluid plastic material over the shrouded mandrels, providing a layer of permeable reinforcement over the latter, assembling the upper half of the molding in a position determined previously relative to the lower half, and tightening it against the resistance provided by the fluid plastic material;

3. The mandrels present a triangular transverse section and are aligned in the direction of the chord, on material composing the lower half of the molding for the external lateral surfaces of a first group of triangular mandrels, that are shrouded so that the peaks of the mandrels extend away from the molding's lower half, then, near the mandrels, a second group of triangular shrouded mandrels is arranged in an alternating series, so that their peak is near the lower half of the molding and their lateral outer surfaces are directed upwards.

B. A molding device with two complementary halves for the wings, including a lower half of a structurally-shaped molding, an upper half of a structurally-shaped molding, a means associated with the molding halves so as to establish the desired internal height of the molding, a means of tightening that applies pressure on the molding halves, and internal mandrels whose form and volume correspond to the

desired empty spaces within the interior of the wings, a device characterized by the following points, either separately or in combination:

1.The mandrels present means to place them freely into position, to adjust their position so as to equilibrate the internal pressure existing within the molding.

2. The mandrels present a generally triangular section and peaks toward the interior, near the internal surface of the molding's structurally shaped interior surface;

3. The positioning means include extensions of mandrels that extend beyond the profiled molding halves, at one extremity of the latter, with each extension presenting a transversal bore and a gudgeon passing through the latter;

4. The molding halves define a cavity that tapers from a larger basal extremity toward a smaller end extremity, and the internal mandrels taper correspondingly;

5. Abutments are provided at the basal extremity in order to maintain the installation in the direction of the mandrels' spans, counter to internal pressure prevailing within the molding.

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3 tables.- Table I

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

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3 tables.- Table III

FIG. 6

FIG. 7

FIG. 8

FIG. 9